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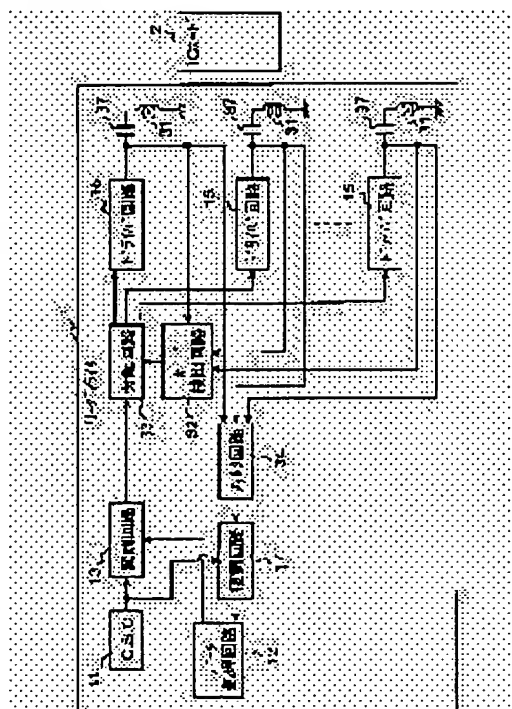
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(54) READER/WRITER AND NON-CONTACT IC CARD SYSTEM

(57)Abstract:

PROBLEM TO BE SOLVED: To reduce the strength of electromagnetic field caused by the antenna of a reader/writer away from a device.

SOLUTION: Concerning a reader/writer 1 for transmitting power to an IC card 2 with no contact and transmitting/receiving communication with the IC card 2 with no contact, this device is provided with plural antennas 31 arranged in the shape of array for transmitting power to the IC card 2, a card detecting means 32 for detecting the information of locating the IC card 2 near on the plural antennas 31 and a means 33 for selecting any antenna for transmitting power to the IC card 2 based on the position information of the IC card 2 detected by the card detecting means 32. By transmitting power from the antenna near the IC card 2 to the IC card 2, the strength of electromagnetic field away from the device is reduced and the communication area of wide range is provided.



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DETAILED DESCRIPTION

[Detailed Description of the Invention]**[0001]**

[Field of the Invention] This invention relates to a non-contact IC card system between IC cards at the reader/writer equipment list which performs transmission and reception of transfer of power and a communication link by non-contact.

[0002]

[Description of the Prior Art] An example of the conventional non-contact IC card system is shown in drawing 8. drawing 8 -- setting -- 1 -- reader/writer and 2 -- an IC card and 11 -- OSC (oscillator) and 12 -- a data-processing circuit and 13 -- a modulation circuit and 14 -- a gain control circuit and 15 -- a driver circuit and 16 -- an antenna and 17 -- for k detector and 21, as for a demodulator circuit and 23, an antenna and 22 are [a demodulator circuit and 18 / amplifier and 19 / a data-processing circuit and 24] modulation circuits. The subcarrier for the transfer of power outputted from OSC11 and the signal for the communication link transmission from the data-processing circuit 12 are made to superimpose in a modulation circuit 13, and it becomes irregular, adjusts to output gain required for the communication link with IC card 2 in the gain control circuit 14, amplifies in a driver circuit 15, and transmits to IC card 2 through an antenna 16. If an antenna 21 receives the signal for the transfer of power from reader/writer 1, and the signal for communication link transmission, it rectifies in a rectifier circuit 25 about the signal for transfer of power, and is supplied to the data-processing circuit 23 grade which changes into desired direct current voltage in a power circuit 26, and consists of a CPU etc., and about the signal for communication link transmission, it will get over, and IC card 2 will input in a demodulator circuit 22, and will perform data processing in the data-processing circuit 23. It becomes irregular in a modulation circuit 24, and the signal which the data-processing circuit 23 outputs is transmitted to the antenna 16 of reader/writer 1 through an antenna 21. It will get over in a demodulator circuit 17, and reader/writer 1 will perform data processing in the data-processing circuit 12, if an antenna 16 receives the signal of the communication link from IC card 2. Furthermore, reader/writer 1 amplifies the signal received from IC card 2 with the antenna 16 with amplifier 18, and outputs it to the k detector 19. The k detector 19 detects the antenna-coupler-control multiplier k between reader/writer 1 and IC card 2 from the amplitude of the signal inputted from amplifier 18, and outputs it to the gain control circuit 14. The gain control circuit 14 adjusts the output gain of reader/writer 1 so that it may be proportional to the inverse number of the antenna-coupler-control multiplier k received from the k detector 19. About this kind of non-contact IC card system, it is known for JP,8-191259,A etc., for example.

[0003]

[Problem(s) to be Solved by the Invention] In the non-contact IC card system described above, for example like an automatic ticket gate, while IC card 2 moves, in the case of the use gestalt which communicates with reader/writer 1, the wide range area which can be communicated is needed. For this reason, compared with the size of the antenna 21 of IC card 2, the antenna 16 in reader/writer 1 is large-sized-ized, and secures a wide range communications area. Thus, when the antenna 16 of reader/writer 1 is large-sized-ized, distant electromagnetic-field reinforcement will increase in proportion to the area of

an antenna 16. So, in order to make the regulation of the electromagnetic-field reinforcement of the distant place by Wireless Telegraph Law etc. suit, shielding for weakening distant electromagnetic-field reinforcement was needed for the exterior of an antenna 16, and the cost rise was caused. if the antenna 16 of reader/writer 1 is large-sized-ized, in order [moreover,] to supply the power with which a coupling coefficient with the antenna 21 of IC card 2 falls, and IC card 2 operates -- output power -- not increasing -- it did not obtain but had become the factor in which this also increases distant electromagnetic field.

[0004] The purpose of this invention is to offer the reader/writer equipment list non-contact IC card system which enabled it to fully supply the power with which the electromagnetic-field reinforcement of the distant place generated from reader/writer equipment is stopped that the above-mentioned technical problem should be solved, and an IC card operates by the electromagnetic wave.

[0005]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, this invention is reader/writer equipment which transmits and receives transfer of power and the communication link by non-contact between IC cards by non-contact to an IC card. Two or more antennas arranged in the shape of [for performing transfer of power to said IC card] an array, It is characterized by having a card detection means to detect the information in which said IC card is located in near on these two or more antennas, and a means to choose the antenna which performs transfer of power to an IC card based on the positional information of the IC card detected with this card detection means. Moreover, two or more antennas which this invention is reader/writer equipment which transmits and receives transfer of power and the communication link by non-contact between IC cards by non-contact to an IC card, and have been arranged in the shape of [for performing transfer of power to said IC card] an array, A card detection means to detect the information in which said IC card is located in near on these two or more antennas, An IC card successive range prediction means to predict the successive range where an IC card may move from the location of the IC card detected with this card detection means, It is characterized by having a means to choose the antenna which performs transfer of power to an IC card, based on the successive range predicted with the positional information of the IC card detected with said card detection means, and said IC card successive range prediction means.

[0006] Moreover, this invention is reader/writer equipment which transmits and receives transfer of power and the communication link by non-contact between IC cards by non-contact to an IC card. Two or more antennas arranged in the shape of [for transmitting and receiving transfer of power and a communication link between IC cards to said IC card] an array, It is characterized by having a card detection means to detect the information in which said IC card is located in near on these two or more antennas, and a means to choose the antenna which performs transmission and reception of transfer of power and a communication link to an IC card based on the positional information of the IC card detected with this card detection means. Moreover, this invention is reader/writer equipment which transmits and receives transfer of power and the communication link by non-contact between IC cards by non-contact to an IC card. Two or more antennas arranged in the shape of [for transmitting and receiving transfer of power and a communication link between IC cards to said IC card] an array, A card detection means to detect the information in which said IC card is located in near on these two or more antennas, An IC card successive range prediction means to predict the successive range where an IC card may move from the location of the IC card detected with this card detection means, It is characterized by having a means to choose the antenna which performs transmission and reception of transfer of power and a communication link to an IC card, based on the successive range predicted with the positional information of the IC card detected with said card detection means, and said IC card successive range prediction means.

[0007] Moreover, this invention is characterized by having a filter means to extract the signal received with the antenna with still higher sensibility among said two or more antennas, and a recovery means to restore to the signal extracted with this filter means, and to change into received data in said reader/writer equipment. Moreover, this invention is characterized by being the information on an antenna that an IC card is located, as information in which the IC card detected with said card detection

means is located in said reader/writer equipment. Moreover, this invention is characterized by constituting said card detection means so that the information in which the electrical potential difference or current generated at the antenna which approached is compared, and an IC card is located may be detected in said reader/writer equipment. Moreover, this invention is characterized by having had a detection means to detect the information in which an IC card is located based on the phase contrast of the signal by which incidence is carried out with the wave source which said card detection means is made to correspond to said antenna, and generates a supersonic wave, and the supersonic wave generated in this wave source, in said reader/writer equipment, and constituting. Moreover, this invention is characterized by having had a light-receiving means to detect the information in which an IC card is located by receiving whether the light which emitted light in the source of luminescence which makes said card detection means correspond to said antenna, and makes light emit light, and this source of luminescence was interrupted with the IC card, in said reader/writer equipment, and constituting.

[0008] This invention is a non-contact IC card system which communicates by non-contact between reader/writer and an IC card. Moreover, to said reader/writer Two or more antennas arranged in the shape of [for performing transfer of power to said IC card] an array, It is characterized by having a card detection means to detect the information in which said IC card is located in near on these two or more antennas, and a means to choose the antenna which performs transfer of power to an IC card based on the positional information of the IC card detected with this card detection means. This invention is a non-contact IC card system which communicates by non-contact between reader/writer and an IC card. Moreover, to said reader/writer Two or more antennas arranged in the shape of [for performing transfer of power to said IC card] an array, A card detection means to detect the information in which said IC card is located in near on these two or more antennas, An IC card successive range prediction means to predict the successive range where an IC card may move from the location of the IC card detected with this card detection means, It is characterized by having a means to choose the antenna which performs transfer of power to an IC card, based on the successive range predicted with the positional information of the IC card detected with said card detection means, and said IC card successive range prediction means.

[0009] This invention is a non-contact IC card system which communicates by non-contact between reader/writer and an IC card. Moreover, to said reader/writer Two or more antennas arranged in the shape of [for transmitting and receiving transfer of power and a communication link between IC cards to said IC card] an array, It is characterized by having a card detection means to detect the information in which said IC card is located in near on these two or more antennas, and a means to choose the antenna which performs transmission and reception of transfer of power and a communication link to an IC card based on the positional information of the IC card detected with this card detection means. This invention is a non-contact IC card system which communicates by non-contact between reader/writer and an IC card. Moreover, to said reader/writer Two or more antennas arranged in the shape of [for transmitting and receiving transfer of power and a communication link between IC cards to said IC card] an array, A card detection means to detect the information in which said IC card is located in near on these two or more antennas, An IC card successive range prediction means to predict the successive range where an IC card may move from the location of the IC card detected with this card detection means, It is characterized by having a means to choose the antenna which performs transmission and reception of transfer of power and a communication link to an IC card, based on the successive range predicted with the positional information of the IC card detected with said card detection means, and said IC card successive range prediction means.

[0010] Moreover, this invention is characterized by equipping said reader/writer with a filter means to extract the signal received with the antenna with still higher sensibility among said two or more antennas, and a recovery means to restore to the signal extracted with this filter means, and to change into received data in said non-contact IC card system. While being able to stop and satisfy the electromagnetic-field reinforcement in the distant place which can perform efficient transfer of power from reader/writer to an IC card, consequently is specified by Wireless Telegraph Law etc. according to

said configuration as shown in drawing 9 since the antenna size of reader/writer can be brought close to an IC card as explained above, a wide range communications area is realizable.

[0011]

[Embodiment of the Invention] The gestalt of operation concerning this invention is explained with reference to a drawing. First, the gestalt of the 1st operation concerning this invention is explained using drawing 1 -2. Drawing 1 is the outline block diagram showing the gestalt of operation of the 1st of the non-contact IC card system concerning this invention. Drawing 2 is drawing showing the array of the antenna installed in reader/writer equipment, an IC card, and the antenna that are transmitted and received.

[0012] As shown in drawing 2, many (16 [for example,] of 4x4) antennas (coil) 31 were small made reader/writer 1 to magnitude equivalent to the antenna (coil) 21 of IC card 2, and have been arranged in the shape of an array (the shape of a matrix) to it. And it is shown in drawing 2 that Antennas 31a and 31b are located near IC card 2, and transmit and receive between IC cards 2. In addition, the configuration of IC card 2 is constituted as shown in drawing 8. That is, if an antenna 21 receives the signal for the transfer of power from reader/writer 1, and the signal for communication link transmission, it rectifies in a rectifier circuit 25 about the signal for transfer of power, and is supplied to the data-processing circuit 23 grade which changes into desired direct current voltage in a power circuit 26, and consists of a CPU etc., and about the signal for communication link transmission, it will get over, and IC card 2 will input in a demodulator circuit 22, and will perform data processing in the data-processing circuit 23. It becomes irregular in a modulation circuit 24, and the signal which the data-processing circuit 23 outputs is transmitted to the antenna 16 of reader/writer 1 through an antenna 21.

[0013] Furthermore, OSC11 which oscillates a signal with a frequency [for supplying power to IC card 2] of 13.56MHz to reader/writer 1 as shown in drawing 1 (oscillator), The data-processing circuit 12 which processes the data for transmitting and receiving between IC cards 2 (control is also included), The modulation circuit 13 which modulates the signalling frequency for the power transmission obtained from OSC11, and the coded signal which transmits data to an IC card, For example, the card detector 32 which detects that IC card 2 exists in near by detecting change of an impedance from each antenna 31 arranged in the shape of an array, The distribution circuit 33 which distributes the modulating signal acquired from a modulation circuit 13 from the card detector 32 to the antenna 31 with which IC card 2 exists in detected near, The driver circuit 15 which each antenna 31 was made to correspond and was prepared so that the modulating signal distributed from this distribution circuit 33 might be amplified, The filter circuit 34 which supplies only the signal from the received antenna 31 to a demodulator circuit 17, and the demodulator circuit 17 with which restore to the signal acquired from this filter circuit 34, and the data-processing circuit 12 is provided as data are formed. In addition, the output of a driver circuit 15 is connected to the series resonant circuit constituted by connecting a capacitor 37 and an antenna 31 to a serial. It sets to reader/writer equipment 1 especially. Many (for example, 16 pieces) antennas 31 For example, the card detector 32 which arranges in the shape of [of 4x4] an array (the shape of a matrix), detects the antenna 31 with which IC card 2 exists in near, and is notified to the distribution circuit 33, It constituted so that IC card 2, the distribution circuit 33 which supplies a signal to the antenna 31 to transmit, and the filter circuit 34 which supplies only the signal from the received antenna 31 to a demodulator circuit 17 might be formed.

[0014] Hereafter, actuation of the gestalt of the 1st operation is explained. The subcarrier outputted from OSC11 is modulated with the signal from the data-processing circuit 12 in a modulation circuit 13, and it distributes to the driver circuit 15 linked to the antenna 31 which communicates with IC card 2 in the distribution circuit 33, amplifies in a driver circuit 15, and transmits to IC card 2 through an antenna 16. At this time, the distribution circuit 33 outputs a signal only to the antenna 31 which the card detector 32 judged to be card detection, and the antenna 31 of that near. That is, since it may be located between the antennas 31 with which IC card 2 adjoined as shown in drawing 2 when the magnitude of an antenna 31 is comparable as the antenna 21 of IC card 2, it is necessary to distribute the modulating signal (power and transmit data) acquired from a modulation circuit 13 also to the antenna which approaches the antenna detected in the card detector 32 in the distribution circuit 33. Thus, even if it distributes to the

antenna which approached at coincidence, it is small in the supply voltage per piece, and reduction of the electromagnetic-field reinforcement of an equipment distant place can be aimed at, securing a large communications area, since the antenna gain to a distant place community is using the low small antenna 31.

[0015] Furthermore, the signal received from IC card 2 will be taken out from the antenna 31 which transmitted, and a filter circuit 34 will supply it to a demodulator circuit 17. In addition, if it is necessary to amplify an input signal, this amplifying circuit will be inserted in the location where the preceding paragraph of a filter circuit 34 or the latter part is suitable. Moreover, although two or more signals pass in a filter circuit 41 when two or more antennas 31 receive the signal from IC card 2, a limit is not received especially about the selection approach of the signal supplied to a demodulator circuit 17. As explained above, when many antennas have been arranged in the shape of an array, as compared with the case where one big antenna is formed, it is small in the supply voltage per piece, and reduction of the electromagnetic-field reinforcement of an equipment distant place can be aimed at, securing a large communications area, since the antenna gain to a distant place community can use a low small antenna.

[0016] Next, the concrete example of the card detector used with IC card system of the gestalt of the 1st operation is explained. First, the 1st example of the card detector 32 is explained using drawing 3. The 1st example 32a of a card detector is constituted by the electrical-potential-difference comparator 42 which compares the electrical potential difference (impedance) of two signals inputted through amplifier 41 from the antenna 31 contiguous to the amplifier 41 which amplifies the electrical potential difference shown with the impedance of the both ends of the antenna 31 which carried out series connection of each capacitor 37, and outputs the potential difference, and the judgment machine 43 which judges the existence of a card from the level of the inputted electrical-potential-difference value.

[0017] Actuation of this 1st example 32a is explained. The voltage of the signal detected as impedance change from each antenna 31 is amplified with amplifier 41, and it is outputted to the electrical-potential-difference comparator 42. A voltage amplifier 42 carries out the electrical-potential-difference comparison of the signal of two adjacent antennas, and outputs the potential difference to the judgment machine 43. If the judgment machine 43 is more than level with the absolute value of the electrical potential difference of the inputted signal, it will output the signal which shows that it is a candidate for a communication link with IC card 2 about an antenna with the inputted higher electrical potential difference. Since it becomes more than level with the absolute value of the output of at least one electrical-potential-difference comparator since the signal of an adjacent antenna was compared when IC card 2 comes to near, or when it separates, it can judge whether an IC card is in near, or there is nothing.

[0018] Next, the 2nd example of the card detector 32 is explained using drawing 4. 2nd example 32b of a card detector arranges the wave source 51 which generates a supersonic wave, and the phase comparator 52 which compares the phase of the inputted signal, and is constituted so that each antenna 31 arranged in the shape of an array on reader/writer 1 may be countered. That is, a wave source 51 and a phase comparator 52 are arranged to the opposed face of each antenna 31.

[0019] Actuation of this 2nd example 32b is explained. In the case of this 2nd example, IC card 2 will be inserted between an antenna 31 and card detector 32b. Then, when there is nothing on the antenna with which IC card 2 counters, it reflects in respect of an antenna and incidence of the supersonic wave which the wave source 51 outputted is carried out to a phase comparator 52. It is based on the phase at this time. Next, if it exists on the antenna with which an IC card counters, a supersonic wave is reflected in respect of an IC card, and since it is inputted into a phase comparator 52, a phase will shift. It is detectable on which antenna IC card 2 exists because a phase comparator 52 detects this gap.

[0020] Next, the 3rd example of the card detector 32 is explained using drawing 5. 3rd example 32c of a card detector consists of sources 61 of luminescence arranged between the antennas 31 arranged in the shape of an array, such as infrared light and a fluorescent light, and an illuminance comparator 62 which is a means to observe the illuminance arranged by the opposed face of an antenna. That is, the source 61 of luminescence arranges the illuminance comparator 62 to the opposed face of an antenna at an antenna side. Actuation of this 3rd example 32c is explained. In the case of this 3rd example, IC card 2 will be

inserted between an antenna 31 and the illuminance comparator 62. Then, the light which the source 61 of luminescence outputted is irradiated by the direct illuminance comparator 62 when an IC card does not exist in near. It is based on the illuminance at this time. Next, if IC card 2 exists in near, since the light which irradiates the illuminance comparator 62 will be interrupted, an illuminance falls. It is detectable on which antenna IC card 2 exists because the illuminance comparator 62 detects this difference.

[0021] Next, the gestalt of the 2nd operation concerning this invention is explained using drawing 6 -7. Drawing 6 is the outline block diagram showing the gestalt of operation of the 2nd of the non-contact IC card system concerning this invention. It is drawing showing the array of the antenna installed in reader/writer equipment, the IC card which can be set without prediction, the antenna which are transmitted and received, the IC card in those with prediction, and the antenna which are transmitted and received in drawing 7 . In the gestalt of the 2nd operation, a different point from the 1st operation gestalt is a point of having formed the card actuation prediction circuit 35 between the card detector 32 and the distribution circuit 33. Other components are the same as the component of the non-contact IC card system shown in drawing 1 . Then, about other components, the same sign as the sign shown in drawing 1 will be attached.

[0022] For example, when the antenna 31 of reader/writer 1 is larger than the antenna 21 of IC card 2, the antenna for a communication link changes during a communication link, and a communication link error may be caused. Then, as shown in drawing 7 , the card actuation prediction circuit 35 also predicts the antenna (antenna predicted as a direction to which IC card 2 is moved) which can be predicted as a following candidate for a communication link from the location of the antenna which is the candidate for the present communication link detected in the card location detector 32, and provides the distribution circuit 33 with the signal over the antenna this predicted. The distribution circuit 33 is changed into the condition that the antenna which can be predicted as a following candidate for a communication link can also communicate, by distributing the modulating signal acquired from a modulation circuit 13 also to the antenna which is a candidate for a current communication link, and the antenna which can be predicted as a following candidate for a communication link. Thereby, the path which an IC card passes will be in the condition which can already communicate. When magnitude of the antenna 31 of reader/writer 1 is especially made larger than the magnitude of the antenna 21 of IC card 2, I want to reduce the number of the antenna distributed as much as possible to coincidence in the distribution circuit 33 from the semantics which reduces the electromagnetic-field reinforcement of an equipment distant place. However, when located around the antenna with which IC card 2 was detected in the card detector 32, it has possibility of IC card 2 being changed and moved to the adjoining antenna from the antenna detected in the card detector 32, and becoming communication link impossible. Then, in the card actuation prediction circuit 35, without producing a communication link error from the location of the antenna which is the candidate for the present communication link detected in the card location detector 32 by predicting migration of IC card 2 and making a modulating signal distribute by the distribution circuit 33 to the antenna this predicted, efficient transfer of power can be performed and the electromagnetic-field reinforcement of an equipment distant place can be reduced.

[0023] In addition, as shown in drawing 2 , when size of the antenna 31 of reader/writer 1 is made into the size and equivalent extent of an antenna 21 of IC card 2, the card actuation prediction circuit 35 can be formed between the card detector 32 and the distribution circuit 33, and based on migration prediction of the IC card by the card actuation prediction circuit 35, the distribution circuit 33 can distribute the modulating signal (a power transmission signal and signal transmission) acquired from a modulation circuit 13 to the suitable antenna 31.

[0024]

[Effect of the Invention] Since according to this invention antenna size of reader/writer can be made into antenna size with a big coupling coefficient to a card antenna and efficient transfer of power can be performed, the effectiveness that the electromagnetic-field reinforcement of an equipment distant place can be reduced is done so. Moreover, since according to this invention a wide range communications area can be realized and efficient transfer of power can moreover be performed by arranging the antenna

of reader/writer in the shape of an array, and choosing an antenna according to migration of an IC card, the effectiveness that the electromagnetic-field reinforcement of an equipment distant place can be reduced is done so.

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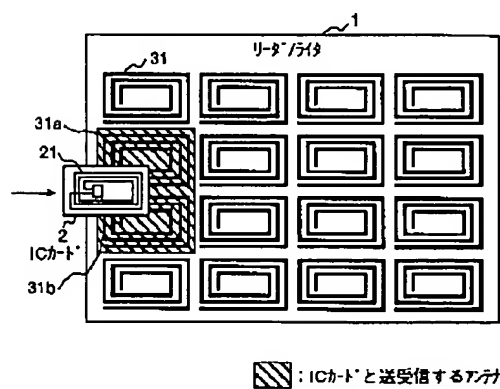
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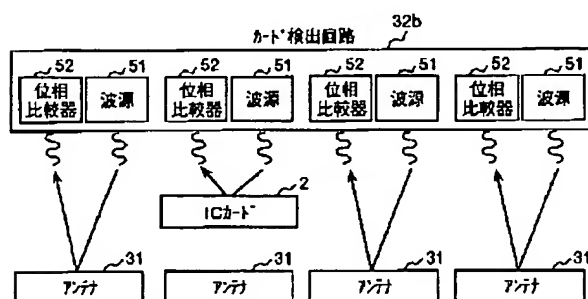
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図 2



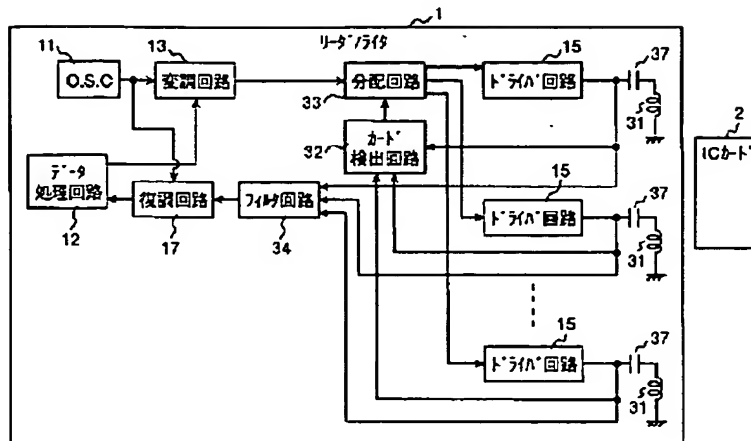
[Drawing 4]

図 4



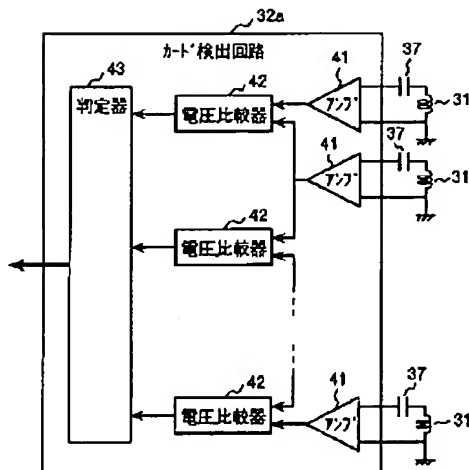
[Drawing 1]

図 1



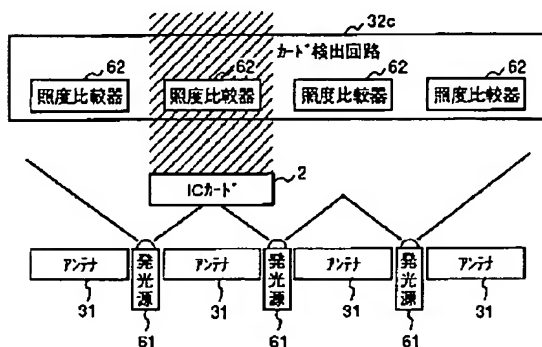
[Drawing 3]

図 3



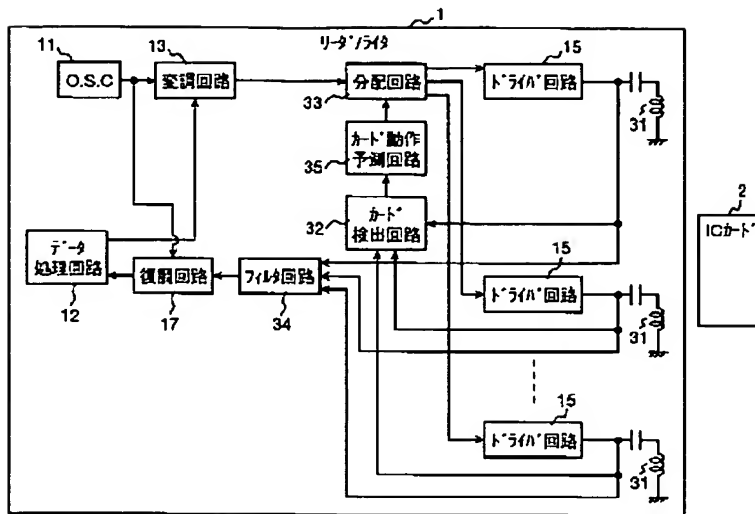
[Drawing 5]

図 5



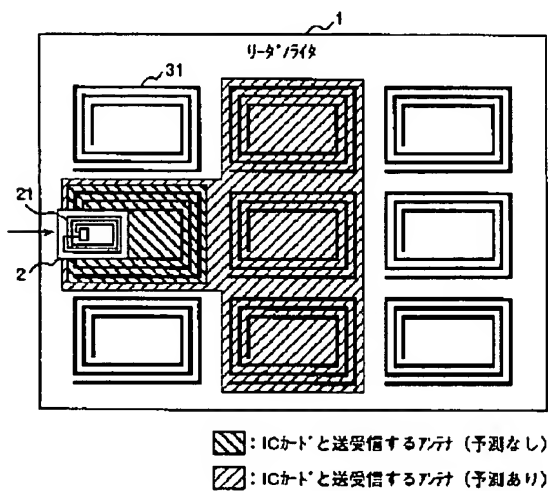
[Drawing 6]

図 6



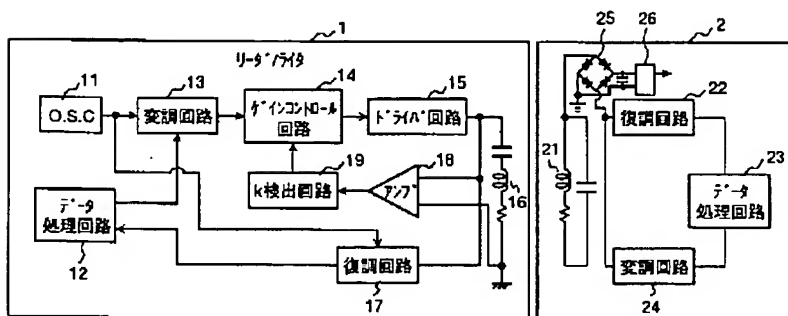
[Drawing 7]

図 7



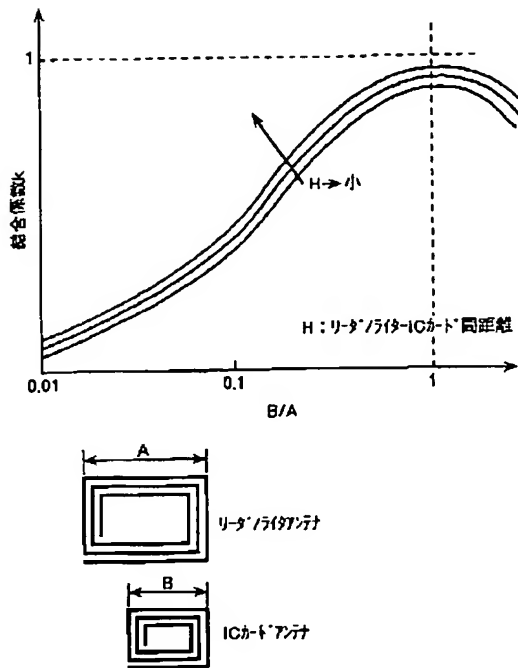
[Drawing 8]

図 8



[Drawing 9]

図 9



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